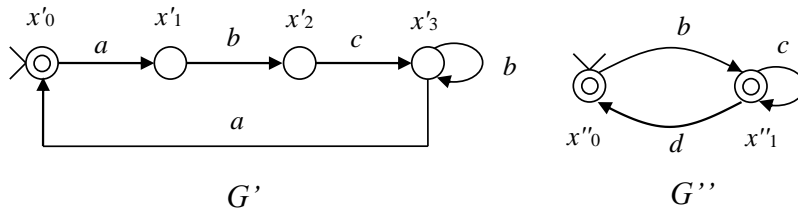


Analysis and Control of Cyber-Physical Systems

Homework 3 — 1 April 2022

Problem 1. A system G consists of two modules modeled by the automata in figures.

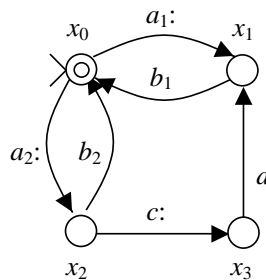


- What are the alphabets of the two DFA?
- Determine the DFA $G = G' \parallel G''$.
- We say that a property P is invariant by concurrent composition if:

$$G' \text{ and } G'' \text{ enjoy property } P \quad \implies \quad G' \parallel G'' \text{ enjoys property } P.$$

Is blockingness invariant by concurrent composition?

Problem 2. In a ceramics workshop, a kiln is used to heat pottery in two different modes. In the first mode, glazed stoneware is produced at high-fire: the beginning and completion of this operation is denoted by events a_1 and b_1 . In the second mode, terracotta is produced at low-fire: the beginning and completion of this operation is denoted by events a_2 and b_2 . Once a low-fire processing has started, the operator may decide to increase the temperature by pushing a button (event c): in this case after a certain delay the temperature reaches the level of a high-fire operation (event d). The DFA G in the figure describes this process. The set of controllable events is $E_c = \{a_1, a_2, c\}$.



- Describe the physical meaning of each state of the DFA.
- Determine the specification automaton H generating and accepting the following specification language K : the first operation completed by the kiln must be a low-fire one (b_2) and two consecutive completion operations cannot belong to the same mode.
- Determine the extended specification automaton \hat{H} . Can this DFA generate a word that is not legal?
- Determine a maximally permissive supervisor S that enforces the specification. Discuss if this automaton is reachable: is this an issue?
- Is the possibility of increasing the temperature once a low-fire operation has started a useful feature? Would it have been better to buy a cheaper kiln which does not have this feature?

The two problems can be solved with software DESUMA <https://wiki.eecs.umich.edu/desuma/index.php/DESUMA>